THIRTY YEARS OF RESEARCH THROUGH THE GEORGIA WATER INSTITUTE

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Abstract. An overview of water resources research sponsored from 1965 to 1994 under the Water Resources Research Act of 1964 and its successor laws is presented. Titles of technical completion reports printed in the Institute publication series are listed by topical categories to indicate the range of interests of the Georgia water research community in the university system, and the needs to which investigators responded. The benefits of the program for state water management professional and university researchers are evaluated and recommendations are given for future activities.

INTRODUCTION

The Water Resources Research Act of 1964 is a legislative success that should counteract some of the cynical views of the political arena. The Act addresses the important topic of water management; it prescribes a sensible solution for one aspect -- research -- by establishing a direct connection between state officials and university researchers; it recognizes the desirability of having each state solve its own problems; and it provides modest funds for a structure that each state may expand in response to its needs. This program has been given nonpartisan support by Congress for three decades.

The program operates in each state through a water resources research institute at a university with joint Federal and state funding. It generates a steady stream of research solutions to local problems to meet its core purpose, advances water-related knowledge in a variety of disciplines, and trains water resources professionals by hands-on graduate-level research.

At the Georgia institute, water resources research performed since 1965 has produced results given in the more than 200 completion reports of the institute publication series listed in Table 1. Most of the information is available to professionals and the public in journal articles and conference presentations. The work was performed by approximately 150 researchers in the Georgia university system. Most were at the University of Georgia, the Georgia Institute of Technology, and Georgia State University, but research-oriented professors at smaller colleges also contributed. More than 100 graduate students and some undergraduates participated in this research; many wrote theses based on their research and all received training for possible future careers in water resources management, teaching or research. The titles of the research completion reports are listed here to indicate the information available from the institute and suggest fruitful areas of research in Georgia.

PROCEDURE

The Federal program currently is directed by the Geological Survey of the U.S. Department of the Interior. It requires Congressional authorization every four years and appropriations every year. Each state institute operates its own system in compliance with Federal regulations. The institutes participate in their own national and regional organizations to cooperate, exchange information, and avoid duplication.

The Georgia institute is guided by a policy advisory committee of university administrators and a research program development committee of professionals and interested citizens. The research committee identifies topics of major concern for state water management that appear susceptible to research solutions. These are targeted in the requests for proposals that the institute issues annually. The projects that researchers at schools prepose for the annual program are evaluated by peer review. Matching funds for the selected projects must be provided by the principal investigator's school.

Until 1980, the research program was organized at three levels of intensity: (1) 5 or 6 small projects to assist in beginning a new line of research, test an idea, or add value to an existing project, staffed by a graduate student supervised by a professor for one year, (2) 2 or 3 larger one-year projects by a professor who devotes a significant fraction of research time to it and supervises a graduate student; and (3) a major multi-year and multi-discipline project. In 1980, reduction in Federal spending decreased the program to the first level only.

DISCUSSION

Even a brief scrutiny of the tabulated research titles indicates the wide range of topics pertaining to Georgia that was addressed, the direct applicability of the reports to solving major local problems, the outstanding professionals who participated, and the scientific and technical contributions that reach beyond local concerns. Notable studies were performed to examine approaches to maintain sufficient quantity and quality of water for municipalities, industry, and agriculture, assure effluent water quality from industries such as those producing textiles and paper, reduce pollution from agriculture and silviculture, control surface runoff from construction sites, monitor water quality and ecological health, define and quantify surface and subsurface water flow, manage water use, and consider social impacts of water management options.

The water institute approach to water research is particularly useful because it fills a gap -- the need for state-oriented information -- among the Federally funded studies performed by agencies such as the USEPA, USDA, USDI, and DOD Corps of Engineers. The results are highly cost-effective: numerous benefits were achieved at modest cost. The research presented in all of the publications in Table 1, including institute management, cost the Federal government just above 5 million dollars, and was matched approximately equally by local funds. Important ancillary benefits for the water community include student training and timely information exchange among professionals and citizen by means such as this conference (which is partially sponsored by the program) and a newsletter.

For the future, the institute plans to continue searching for suitably-sized projects by skilled researchers to assist water resources managers in solving Georgia's needs with current science and technology. Recent work, listed at the top of each category in the Table, indicates current concerns. Proposals will continue to be solicited from researchers at universities throughout Georgia. Efforts will continue to be devoted to expanding the program so that both more and larger projects can be supported. The reader's suggestions concerning topics, format, and sources of support are welcome.

Table 1.
Research Reports, 1966-1995

Surface Water Flow

Control Models for Hydropower System and Operation. Georgakakos, et al.

A New Reservoir Control Approach with Application to the Management of Lake Lanier. Georgakakos and Yao

The Value of Forecasting in Reservoir Operation. Georgakakos

Field Methods for Estimating Drought Streamflow Reduction Due to Pumping from Nearby Wells. Dowd and Smith

Development of Confidence Intervals and Monthly Design Values for Low Streamflows. McCormick and Reeves

Microcomputer Program for Estimating Drought Stream flow Reduction Due to Pumping from Nearby Wells. Dowd, et al.

Coastal - A Distributed Hydrologic Simulation Model for Lower Coastal Plain Watersheds in Georgia. Sun and Brook

Estimating Flood Damages in the State of Georgia. Debo

Methods of Low Flow Predictions for Small Georgia Streams. Wallace, et al.

Comparison of the Georgia Tech, Kansas, Kentucky, Stanford and TVA Watershed Models in Georgia. Lumb

Hydrologic, Economic, Ecologic, Social, and Well-Being Factors in Flood Control Measures for Urban Streams. James, et al.

GTWS: Georgia Tech Watershed Simulation Model. Lumb, et al.

Reservoir Project Reauthorization: Examples of Past Use and Analysis of Application to Lake Lanier. Holley and Kane

Analysis of Urban Land Treatment Measures for Flood Peak Reduction. Lumb, et al.

Travel Time of Georgia Streams. Lumb

The Relationship of Land Use to Domestic Surface Water Supply in Georgia. Shaw and Nutter

Physical and Chemical Properties of the Coastal Waters of Georgia. Kuroda and Marland

Volume Transport, Salinity Distribution and Net Circulation in the Duplin Estuary. Kjerve

Role of Sediment Gradation on Channel Armoring. Little and Mayer

The Peachtree Creek Watershed as a Case History in Urban Flood Plain Development. James, et al.

The Effects of Land Use Change on the Hydrology of an Urban Watershed. Wallace

Remedial Flood Plain Management as the Focus for an Experiment in Interdisciplinary Team Research. James

Numerical Solution of Transient Supercritical Flow with Technique for Simulating Bore Propagation. Zovne

A Study of Flow Conditions in Shaft Spillways. Mussalli and Carstens

A Stochastic Model for the Response of Permanent Offshore Structures to Soil Restrains and Wave Forces. Edge and Mayer

Seepage Flow Through an Earth Dam. Carstens and May

Surface Water Quality

Computerizing Infiltration Design Procedures. Debo

Mercury Storage and Mobility in Floodplains of the Dahlonega Gold Belt. Leigh

Sediment Basin Design for Landfills and Construction Sites. Sturm

Effects of the Interaction of Clay, Phosphorus and Organic Particulates on the Trophic Status of Lake Lanier. Mayhew and Mayhew

Use of Modified Benthic Bioassessment Protocols for Evaluation of Water Quality Trends in Georgia. Cowie, et al.

Sediment Reduction in Urban Stormwater Runoff. Sturm and Kirby

Release of Alkaline Earth, Alkali, and Toxic Metals from Sediments Georgia. Cowie and Cooley

Effect of Soil Dispersion of Surface Run-off in Southern Piedmont in Coastal Soils. Ghuman and Raut

Guidelines for Development of Watershed Protection Programs in Soils. Radcliffe, et al.

Alluvial Streambed Degradation. Sturm and Skolds

Potential of Palygorskite as a Sediment Tracer. Carver and French

Search for Nitrifying Agents in Water and Soils as Sources of Nitrates in Surface Water. Phillips and Todd

Budgets of Selected Mineral Nutrients for Two Watershed Ecosystems in the Southeastern Piedmont. Krebs and Golley

Effect of Polyester Fiber Processing Effluents on Water Quality. Tincher

The Interaction of Water with Organic Solute Species. Liotta, et al.

A Study of the Effects of Island Development on Lake Water Quality. McClanahan and Hoadley

Sediment Water Interactions in Some Georgia Rivers and Estuaries. Beck

Structure and Properties of Water Solutions. Pierotti and Liabastre

Chemical Characterization of Dissolved Organic Matter and its Influence on the Chemistry of River Water. Reuter and Perdue

Transition Metals Impounded in Waters. Heise

Laboratory and Mathematical Simulation of Oxygen Balances Effected in Streams. Gates

Removal of a Spherical Particle from a Flat Bed. Chen

Complex Systems Analysis of Water Quality Dynamics: The Feedback Systems Structure. Knight and Hines

Diffusion of Particles by Turbulence: Effect of Particle Size. Majumdar and Carstens

Salt-Water Intrusion Effect of a Fresh-Water Canal. Carstens and May

Ground Water

Well Siting Using Geostatistical Analysis of Discrete Fracture Data, Part A: Fracture Analysis. Babaie and Caudill

Well Siting Using Geostatistical Analysis of Discrete Fracture Data, Part B: Geostatistical Analysis. Rouhani, et al.

Environmental Isotope Systematics for Investigation of Groundwater Pumping in Piedmont Province. Rose

An Oxygen Isotopic Data Base for the Coastal Plain of Georgia. Wenner

Storativity of the Floridian Artesian Aquifer in Georgia. Carver

Geostatistical Co-estimation of Ground Water Flow Parameters. Rouhani and Torak

Environmental Tritium as Tracer of Groundwater Flow in the Piedmont Province of Georgia. Rose

Northeast Georgia Temporal and Spatial Variations in the Radon Content of Ground Water. Simones, et al.

Modeling Transient Ground Water Flow in Multilayered Aquifer Systems. Aral and Haddad

Instantaneous Unit Hydrographs: A Geomorphologic Approach. Georgakakos and Kabouri

Simplified Regional Multilayered Aquifer Analysis. Aral

Fracture Trace Analysis to Increase the Probability of Locating Groundwater in Murray County, Georgia. Tschirhart, et al.

Geological Factors Influencing Well Productivity on the Georgia Piedmont. Brook, et al.

Parameter Identification in Layered Aquifer Systems. Aral and Zakikhani

Municipal Use of Existing Wells for Supplemental Water Supply in the Piedmont and Blue Ridge. Kundell and Chambers

Identification and Assessment of Effluent Residuals in Treated Leachate form Landfill Disposal Sites. Pohland, et al.

Aquifer Parameter Prediction by Numerical Modeling. Aral and Kuniansky

Predicting Capacities of Wells Penetrating the Ocala Aquifer Beneath the Dougherty Plain, Southwest Georgia. Brook and Sun

The Applicability of Large-Diameter Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia. Beck

Analysis of the Development of Shallow Groundwater Supplies by Pumping from Ponds. Aral, et al.

Ponds as Shallow Wells in the Georgia Coastal Plain. Beck

Multivariate Analysis of Georgia Coastal Plain Groundwaters. Pollard, et al.

Validity of Darcy's Law For Flow in Natural Sands. Carver

Studies of Saprolite and Its Relation to the Migration and Occurrence of Groundwater in Crystalline Rocks. Howard

The Transport of Radioisotopes by Fine Particulate Matter in Aquifers. Champlin

Changes in Clay-Water System with Depth, Temperature and Time. Weaver and Beck

Movement of Micron-Size Particles Through a Sand Bed. Champlin

Agricultural Water and Pollutants

Validation of GLEAMS Model for Poultry Litter Management. Knisel, et al.

Water Quality Impacts of Poultry Litter Management. Smith and Sellers

Assessing Dairy Lagoon Seepage Using Ground Electromagnetic Conductivity. Drommerhausen, et al.

Evaluating the Effect of a Restored Wetland of Nutrient Movement from a Farm Animal Waste Application Site. Vellidis, et al.

Water Withdrawals for Irrigation in Drought Years. Hook

Turfgrass Water Use, Drought Resistance and Rooting Patterns in the Southeast. Carrow

Water Use, Drought Resistance and Rooting Patterns of Turfgrass in the Southeast. Carrow

Evaluation of Subsurface and Outflow Water Quality from Drainage Subirrigation Systems in the Georgia Flatwoods. Thomas, et al.

Drainage-Subirrigation System Evaluations for Georgia Flatwoods. Shirmohammadi

Long Term Sediment Deposition in the Riparian Zone of an Agricultural Watershed. Lowrance, et al.

The Effect of Hydroperiod on Floodplain Forest Production. Birch and Cooley

Irrigation System Efficiency Survey for Georgia. Stansell, et al.

Prediction of Irrigation Water Demands in the Southeastern United States. Chesness and Cochran

Agricultural Water Demand Prediction Using Remote Sensing Technology for Georgia Water Resource Management. Jensen

An Improved Sediment Delivery Model for Piedmont Forests. Burns

Contamination of Water by Air Pollutants, Especially Ammonia from Animal Manures. Giddens

Moisture and Energy Conditions in a Drainage Soil Mass. Nutter

Soil-Water-Plant Relations Utilizing Divided Root System of Soybean. Michel

Cost of Waste Water Pollution Abatement in Poultry Processing and Rendering Plants in Georgia. Kerns and Holemo

Microbial Changes and Possible Ground Water Pollution from Poultry Manure and Beef Cattle Feedlots in Georgia. Giddens, et al.

Water and Wastewater Treatment

Mechanisms of Microbial Detachment During Biological Filtration and Backwashing. Ahmad and Amirtharajah

Modified Clays as Sorbents for Aromatic Hydrocarbons in Aqueous and Mixed-solvent Systems. Nzengung, et al.

Anaerobic Digestion of Industrial Activated Aerobic Sludge. Papas, et al.

Cadmium Removal and Recovery by Magnesium Cementation. Gould, et al.

Kinetic Model for Ozonation of Toxic Water Contaminants. Saunders, et al.

The Application of Kaolin for Control of Heavy Metals in Anaerobic Sludge Digestion. Cross and Rossello

Organic Solvent Regeneration of Granular Activated Carbon. Cross, et al.

An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry. Battaglia, et al.

Enhanced Solar Drying of Wastewater Sludge. Craft

A Variable-Discharge Model for Facultative Oxidation Ponds. Saunders and Minchew

Anaerobic-Activated Carbon Filters for Removal of Refractory and Toxic Organic in Wastewater. Suidan, et al.

Adsorption of Textile Dyes from Aqueous Solution by Activated Carbon from Peanut Hulls. Ernst

Microbial Degradation of Dye Wastes in Aqueous Effluents. Michaels and White

Nitrification with Rotating Biological Contractor Systems. Saunders and Pope

Conservation of Water, Chemicals and Energy in Dyeing Nylon Carpet. Tincher

Oxidation Pond Systems for Wastewater Treatment in Small Communities. Saunders and Clyburn

Bark as Trickling-Filter Dewatering Medium for Pulp and Paper Mill Sludge. Lightsey

Manganese Removal from Potable Water. Ingols and Craft

Land Disposal of Wastewater: Processes, Design Criteria, and Planning Considerations. Hartigan, Jr.

The Electrical Process in the Breaking of Dilute Oil-in-Water Emulsions. Orr, Jr., and Keng

Parabiotic Growth Characteristics of Selected Sewage Bacteria. Fincher

An Examination of the Economic Impact of Pollution Control Upon Georgia's Water-Using Industries. Dodsen and Cassell

Effect of Permeable Sand Bed on Sediment Motion. Martin and Aral

Radiotracer Study of Rapid Sand Filtration. Craft

The Relation of Ion Movement to Fine Particle Displacement in a Sand Bed. Champlin

Determination, Evaluation and Abatement of Color in Textile Plant Effluents. Flege

The Effect of Turbulence on Bacterial Substrate Utilization. Marlar

The Effect of Induced Turbulence on Growth of Algae. Olinger

The Effect of a Permeable Bed on Sediment Motion -- Phase 1: Seepage Force on Bed Particles. Martin

The State of the Art of Water Use and Waste Disposal in the Textile Industry (1950-1966). Jones and Hyden

Analysis and Monitoring

Biomarkers for Managing Water Resources. Snell, et al.

Development of Testing Protocols for Toxicity Assessment of Organic Solvents in Ground Water. Pancorbo, et al.

Optimal Schemes for Ground Water Quality Monitoring in the Dougherty Plain, Southwestern Georgia. Rouhani and Hall

Analysis of Azo Dyes in Water by Liquid Chromatography with a Swept-potential Electrochemical Detector. Sturrock

Correlation Detectors for Selective Detection of Pollutants in Natural Waters. Anderson

Heavy Metal Composition of Treated Municipal Wastewater and Sludge Residues. Ghuman

Analysis of Organic Pollutants in Water by Liquid Chromatography with Swept Potential Electrochemical Detector. Sturrock

Detection of Iodine Species in Dilute Aqueous Solutions. Liotta, et al.

Electrochemical Detectors for Liquid Chromatographic Separation of Pesticide and Coal Phenolic Residues in Water. Anderson

Chemical Characterization of Humic Substances in the Flood Plains of Southeastern U.S. Coastal Streams. Reuter

Optical Remote Sensing of Water Pollutants. Gallagher and McManus

Detection of Trace Phosphorus in Natural Waters by Graphite Oven Flame Analysis. Campbell

The Trace Analysis of Water for Selected Metallic Elements Employing Square-Wave Polarography. Sturrock and Carter

Turbidity Instrumentation: A Fiber-Optic System Measuring Sediment Concentration by Optical Fourier Transformation. McSweeney

The Application of Phase Selective Alternating Current Polarography to the Analysis of Heavy Metals in Water. Sturrock

Determination of Degraded Dyes and Auxiliary Chemicals in Effluents from Textile Dyeing Processes. Flege

Hydraulic Investigations of Tainter Gates as Flow Measuring Devices. Paul and Olmstead

Water Management, Planning

Estimating the Willingness to Pay for Water. Jordan

Forecasting Water Demands for Georgia with the IWR-MAIN Model. Sellers and North

Index to Georgia Water Data Files and Reports. Hatcher

Evaluation of User Charges to Finance Water Services. North, et al.

Construction of an Integrated and Economically Efficient Water Allocation Process for the Flint River. Wright and North

Water Resources Organizations in Georgia. Hatcher and Chambers

Institutional Arrangements for Integrated Water Management in the Southeast. Hatcher and Kundell

Quantitative Models and Analysis of Urban Nonpoint Source Water Pollution Control Systems. Esogbue

Analysis of Alternatives for Cost Sharing Water Resources Projects and Programs. North and Sellars

Permitting Options and Design Procedure for a Controlled-discharge Wastewater Treatment Facility. Hatcher

Water Conservation and Alternative Water Supplies. Wallace and Kahn

Transfer of Systems Technology to Urban Water Management. Esogbue and Willeke

Assessing the Social Effects of Water Quality Management Programs. Willeke

Financing and Cost Sharing Municipal Water Supply Systems. North

Implications of Zoning as an Urban Water Management Measure. Floyd and Rowan

A Simulation Approach to the Analysis of Uncertainty in Public Water Resource Projects. North and Taylor

Georgia County Commissioner Attitudes Toward Water Problems. Marando

Integrative Procedures for Coordinated Urban Land and Water Management: A Systems Analysis. Esogbue

Survey and Analysis of Urban Drainage Ordinances and Recommended Model Ordinance. Debo

Identification of Publics in Water Resources Planning. Willeke

Field Test of an Environmental Impact Assessment Methodology. Smith

Survey of Economic-Ecologic Impacts of Small Watershed Development. North, et al.

The Use of Questionnaires in Collecting Information for Urban Flood Control Planning. James

Community Well-Being as a Factor in Urban Land Use Planning. James

Georgia's Water Problems and Related Research Needs. Willeke, et al.

The Identification and Quantification of the Net Effects of Multiple-Purpose River Basin Development. North and Sellars

Metropolitan Water Management. Willeke and Kroeck

State Organization for Water Resources Management. Elmore, Jr.

A Study of Public Attitudes and Multiple Objective Decision Criteria for Water Pollution Control Projects. Thuesen

The Flood Plain as a Residential Choice: Resident Attitudes and Perceptions in Flood Plain Management. James, et al.

A Citizen Panel for Atlanta Area Studies: Field Experimentations and Methodological Substudies. York and Baskett

Unsteady Flow of Dilute Aqueous Polymer Solutions in Pipe Networks to Improve Water Distribution. Jackson and Mayer

Instruments for Measuring Attitude Toward a Community Water Issue. York

Development and Application of a Rational Water Planning Model. Dysart III, and Hines

Metropolitan Planning and River Basin Planning: Some Interrelationships. Kelnhofer, Jr.

Survey of the Nature and Magnitude of the Water Research Needs of the Textile Industry of Georgia. Hyden, et al.

Ecosystems, Wetlands

Analysis of Wetland Trends and Management Alternatives For Georgia. Woolf and Kundell

The Implications of Productivity in Assessing Ecological Impact in the Tidewater Zone of a Coastal Plain Stream. Gillespie

Microbial Degradation of Lignocellulosic Detritus in Wetland Ecosystems. Hodson and Maccubbin

Valuation and Acquisition of Floodplain Lands for Stream Valley Parks. Floyd

Effects of Urbanization on Stream Ecosystems. Benke, et al.

Environmental Impact of Upland Streams on the Okefenokee Swamp. Blood

Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia. Tietjen and Carter

In-Situ Evaluation of the Filtering Function of a Piedmont Creek Swamp. Wharton and Hopkins

Transference Mechanism of Polychlorinated Biphenyls by Aquatic Organisms. Hamdy

Biological Basis for Assessing Impacts of Channel Modification in a Southeastern Blackwater River. Benke

An Evaluation of the Effect of Drawdown on the Trophic Status of a Small Reservoir. Barman, Jr., and Baarda

Biochemical Transformation and Detoxification of Mercury in Aquatic Environment. Hamdy

Toward Simulation and Systems Analysis of Nutrient Cycling in the Okefenokee Swamp, Georgia. Rykiel, Jr.

Effects of High Levels of Inorganic Phosphate on Aquatic Organisms in Phosphate-Rich Environments. Strange

Capacity of a Spartina Salt Marsh to Assimilate Nitrogen from Secondarily Treated Sewage. Chalmers, et al.

The Cause of Trout Fish Kills Occurring in the Water from the Aerated Hypolimnion of Deep Lakes. Ingols

The Effect of Hypolimnion Discharge upon Age and Growth of the Blue Gill (Lepomis Macrochirus). Dudley and Golden

Buffer Capacity in Aquatic Ecosystems. Pohland and Bolton

Utilization of Organic Phosphorus by Plankton in Phosphorus-Rich Environments. Strange

Volume Transport, Salinity Distribution and Net Circulation in the Duplin Estuary, Georgia. Kjerve

Kinetics of Aerobic Utilization of Mixed Sugars by Heterogeneous Microbial Populations. Ghosh

Water Cycle

Characterization of Acid Rain Phenomena. Beck and Demere

Comparative Study of the Causes and Effects of Recent Southeastern Droughts. Paris and Justus

Basin-scale Evapotranspiration Determination through Watershed and Climate Analysis. Harper, et al.

Sensitivity Analysis of a Thunderstorm Rainfall Model. Wallace and Wang

Digital Simulation of Thunderstorm Rainfall. Sormon and Wallace

Water Law

Legal Aspects of Water Resources: A Survey of the Law in Georgia. Smith

The Law of Surface Water Allocation in Georgia. Smith

Citizen Enforcers: Influencing Water Resources Allocation Decisions. Smith

Georgia Laws, Policies and Programs Pertaining to Water and Related Land Resources. Elmore, Jr.

Cooling Use

Effective Use of Cooling Lakes and Cooling Towers in Hybrid Cooling Systems. Sturm

Heat Dissipation from Turbulent Open Channel Flow. Mayer and Moss